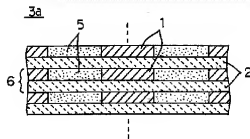


JAPANESE

[JP,2002-043164,A]

Drawing selection

Representative draw



[Translation done.]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

## \* NOTICES \*

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**DETAILED DESCRIPTION**

[Detailed Description of the Invention]

[0001]

[Field of the Invention]In this invention, it is related with a lamination type ceramic electronic component and a manufacturing method for the same.

Therefore, in order to absorb the level difference resulting from the thickness of the internal-circuit-elements film especially formed between ceramic layers, it is related with a lamination type ceramic electronic component provided with the ceramic layer for level difference absorption formed with the negative pattern of an internal-circuit-elements membrane pattern, and a manufacturing method for the same.

[0002]

[Description of the Prior Art]For example, when it is going to manufacture a lamination type ceramic electronic component like a laminated ceramic capacitor, two or more ceramic green sheets are prepared, and these ceramic green sheets are accumulated. On the specific ceramic green sheet, the conductor film for constituting a capacitor, resistance, an inductor, a barista, a filter, etc. and an internal-circuit-elements film like a resistor film are formed according to the function of a lamination type ceramic electronic component made profitably like.

[0003]Electronic equipment including mobile communications equipment in recent years, A miniaturization and a weight saving progress, and in such electronic equipment, when a lamination type ceramic electronic component is used as a circuit element, a miniaturization and a weight saving are strongly required also from such a lamination type ceramic electronic component. For example, in the case of the laminated ceramic capacitor, the demand of a miniaturization and large-scale-izing is increasing.

[0004]When it is going to manufacture a laminated ceramic capacitor, typically, Mix dielectric ceramic powder, an organic binder, a plasticizer, and an organic solvent, and ceramic slurry is produced, This ceramic slurry on a base material like polyester film coated by silicone resin as a remover, etc., By fabricating so that a doctor blade method etc. may be applied, for example, it may become a sheet shaped several micrometers thick, a ceramic green sheet is produced, it ranks second, and this ceramic green sheet is dried.

[0005]Next, the internal electrode as an internal-circuit-elements film is formed on a ceramic green sheet by having two or more patterns which separated the interval mutually on the principal surface of the ceramic green sheet mentioned above, and screen-stencil giving conductive paste, and drying this. Some ceramic green sheets 2 in which it was distributed over two or more places as mentioned above, and the internal electrode 1 was formed are shown to drawing 7 by the top view.

[0006]Next, after the ceramic green sheet 2 exfoliates from a base material and is cut by the suitable size, as a part is shown in [drawing 6](#). The raw layered product 3 is produced by accumulating only predetermined number of sheets and accumulating further only number of sheets predetermined in the ceramic green sheet which does not form the internal electrode in the upper and lower sides of this pile.

[0007]After this raw layered product 3 is pressed in a laminating direction, as shown in [drawing 8](#), it is cut by the size which should serve as the layered product chip 4 for each laminated ceramic capacitor, and ranks second. After passing through a de binder process, a baking process is given and a laminated ceramic capacitor is completed by forming exterior electrodes eventually.

[0008]In such a laminated ceramic capacitor, in order to satisfy the demand to the miniaturization and large-scale-izing, it is necessary to attain increase of the number of laminations of the ceramic green sheet 2 and the internal electrode 1, and lamination of the ceramic green sheet 2.

[0009]However, between the portion in which the internal electrode 1 is located the more as a result of accumulation of each thickness of the internal electrode 1 the more above multilayering and lamination progress, and the portions which are not so. Or as the internal electrode 1 becomes more remarkable in a laminating direction in the difference of the thickness between the portion arranged comparatively and the portion which is not so, for example, it is shown in [drawing 8](#), about the appearance of the obtained layered product chip 4, the modification that on the other hand the principal surface serves as convex will arise. [ many ]

[0010]In the portion in which the internal electrode 1 is not located if modification as shown in [drawing 8](#) in the layered product chip 4 has arisen, or the portion in which only a small number of internal electrode 1 is arranged comparatively in the laminating direction. Since a comparatively big distortion is brought about in the case of [ like a press operator ] and the adhesion between the ceramic green sheets 2 is inferior, it is easy to generate structure defects, such as delamination and a minute crack, by the internal stress caused at the time of calcination.

[0011]Modification of the layered product chip 4 as shown in [drawing 8](#) may cause the result made to transform the internal electrode 1 undesirably, and a short defect may produce it by this.

[0012]Such inconvenience is the cause of reducing the reliability of a laminated ceramic capacitor.

[0013]In order to solve the above problems, as shown in [drawing 2](#), to the field in which the internal electrode 1 on the ceramic green sheet 2 is not formed, for example. Form the ceramic green layer 5 for level difference absorption, and by this ceramic green layer 5 for level difference absorption. Losing substantially the level difference by the thickness of the internal electrode 1 on the ceramic green sheet 2 is indicated to JP,56-94719,A, JP,3-74820,A, JP,9-106925,A, etc., for example.

[0014]As mentioned above, by forming the ceramic green layer 5 for level difference absorption. Between the portion in which the internal electrode 1 is located when the raw layered product 3a is produced, as a part is shown in [drawing 1](#), and the portions which are not so. Or as the difference of the thickness between the portion in which many internal electrodes 1 are arranged comparatively in the laminating direction, and the portion which is not so stops arising substantially and it is shown in [drawing 3](#), in the obtained layered product chip 4a, it becomes difficult to produce undesirable modification as shown in [drawing 8](#).

[0015]As a result, the reliability of the laminated ceramic capacitor which could make hard to produce problems, such as structure defects, such as delamination which was mentioned above, and a minute crack, and a short defect by modification of the internal electrode 1, and was obtained can be improved.

[0016]

[Problem(s) to be Solved by the Invention]Although the ceramic green layer 5 for level difference absorption mentioned above has the same presentation as the case of the ceramic green sheet 2 and is formed by giving the ceramic paste containing dielectric ceramic powder, an organic binder, a plasticizer, and an organic solvent. For example, in order to form the ceramic green layer 5 for level difference absorption by printing etc. with high precision so that it may have thickness comparable as the internal electrode 1 of 2 micrometers or less in thickness, the dispersibility in the end of ceramic powder under SERAMMIKU paste should be excellent.

[0017]In order to obtain ceramic paste by JP,3-74820,A in relation to this, distributed processing with 3 rolls is indicated, but in distributed processing with such mere 3 rolls, it is difficult to acquire outstanding dispersibility which was mentioned above.

[0018]On the other hand, in JP,9-106925,A the ceramic slurry for the ceramic green sheet 2, While producing by mixing dielectric ceramic powder, an organic binder, and the 1st low-boiling-point organic solvent and using this for shaping of the ceramic green sheet 2, By heating and replacing the 1st low-boiling-point organic solvent by the 2nd organic solvent of a high boiling point, after adding the 2nd organic solvent of a high boiling point and mixing from the boiling point of the 1st above-mentioned organic solvent to this ceramic slurry, Producing the ceramic paste for the ceramic green layer 5 for level difference absorption is indicated.

[0019]Therefore, in the ceramic paste obtained by [ as having mentioned above ], since at least 2 times of mixing processes are carried out, the dispersibility in the end of ceramic powder improves to some extent, but. According to these mixing processes, since each is carried out where an organic binder is included, the slurry at the time of mixing or the viscosity of a paste has a limit in having excelled the dispersibility in the end of ceramic powder with the distributed processing machine using media like a ball mill highly.

[0020]Thus, as ceramic paste used in order to form a very thin ceramic layer called the ceramic green layer 5 for level difference absorption which has thickness equivalent to the thickness of the internal electrode 1, The dispersibility outstanding about the end of ceramic powder it is contained there is required, and the demand to such outstanding dispersibility becomes so severe that the thickness of the internal electrode 1 becomes thin.

[0021]Even if it is when the dispersibility in the end of ceramic powder in the ceramic green layer 5 for level difference absorption is temporarily bad, may be able to cover the badness of dispersibility to some extent with the ceramic green sheet 2 piled up on it, but. If the thickness of the ceramic green sheet 2 becomes thin, the effect which covers dispersibility with such a ceramic green sheet 2 is hardly expectable.

[0022]From the above thing, higher dispersibility is needed about the end of ceramic powder in the ceramic green layer 5 for level difference absorption, so that a miniaturization and large-scale-izing of a laminated ceramic capacitor progress.

[0023]Since the distributed efficiency in the end of ceramic powder in a mixing process is raised, it is possible to make viscosity of ceramic paste low, but. Thus, if the addition of the low-boiling-point organic solvent mentioned above is increased in order to make viscosity low, in order to remove this low-boiling-point organic solvent after distributed processing, another problem of needing for a long time is encountered.

[0024]As mentioned above, although it explained in relation to the laminated ceramic capacitor, the same problem encounters also in other lamination type saying other than a laminated ceramic capacitor (for example, a lamination ceramic inductor) ceramic electronic components.

[0025]Then, the purpose of this invention is to provide the lamination type ceramic electronic component obtained by the manufacturing method and this manufacturing method of the lamination type ceramic electronic component which can solve a problem which was mentioned above.

[0026]

[Means for Solving the Problem]This invention is first turned to a manufacturing method of a lamination type ceramic electronic component. In this manufacturing method, the following processes are carried out fundamentally.

[0027]First, ceramic slurry, conductive paste, and ceramic paste are prepared, respectively.

[0028]Next, a ceramic green sheet obtained by fabricating ceramic slurry, An internal-circuit-elements film formed by giving conductive paste selectively so that a level difference by the thickness may be brought about on the principal surface of a ceramic green sheet, Two or more composite structures provided with a ceramic green layer for level difference absorption formed by giving ceramic paste to a field in which it is on the principal surface of a ceramic green sheet, and an internal-circuit-elements film is not formed so that a level difference by thickness of an internal-circuit-elements film may be lost substantially are produced.

[0029]Next, a raw layered product is produced by accumulating a composite structure of these plurality.

[0030]And a raw layered product is calcinated.

[0031]In a manufacturing method of a lamination type ceramic electronic component provided with such a fundamental process, a process, i.e., a method of manufacturing ceramic paste, of preparing ceramic paste for forming a ceramic green layer for level difference absorption has the feature by this invention.

[0032]A primary dispersing process which carries out the distributed processing of the primary mixture which contains the end of ceramic powder, and the 1st organic solvent at least in this invention in order to manufacture ceramic paste, A removal process which removes the 1st organic solvent from a primary mixture selectively with heating after a primary dispersing process, A secondary dispersing process which carries out the distributed processing of the secondary mixture which added an organic binder to a primary mixture from which the 1st organic solvent was removed, and a process which includes the 2nd organic solvent of a high boiling point in a primary mixture and/or a secondary mixture from the 1st organic solvent are carried out after a removal process.

[0033]Here, the organic binder should note being added in a stage of a secondary dispersing process. In this invention, it is characterized by using the 2nd organic solvent of a high boiling point from the 1st organic solvent and this 1st organic solvent. This 2nd organic solvent may be added in a stage of a secondary [ further ] dispersing process, being added in a stage of a primary dispersing process, even if are added in a stage of a primary dispersing process, and added in a stage of a secondary dispersing process.

[0034]In a secondary dispersing process, as for an organic binder, when the 2nd organic solvent is added, it is preferred to be added in the state where it dissolved in the 2nd organic solvent beforehand. An organic binder which dissolved in the 2nd organic solvent beforehand in this way more preferably is added after being filtered.

[0035]On the other hand, when a primary mixture by which distributed processing is carried out in a primary dispersing process contains the 2nd organic solvent further, in a removal process, the 1st organic solvent is removed from a primary mixture, with the 2nd organic solvent left.

[0036]As for a difference of the boiling point of the 1st organic solvent, and the boiling point of the 2nd organic solvent, in an above-mentioned case, it is preferred that it is not less than 50 \*\*.

[0037]In this invention, a process of preparing ceramic paste is after a primary dispersing process, and it is preferred to have further a process of filtering a primary mixture, before a removal process.

[0038]As for ceramic slurry used in order to fabricate a ceramic green sheet, in this invention, it is preferred to include the end of ceramic powder it has the substantially same presentation as the end of ceramic powder it is contained in ceramic paste for forming a ceramic green layer for level difference absorption.

[0039]In a specific embodiment of this invention, it is dielectric ceramic powder both the end of ceramic powder it is contained in ceramic slurry and ceramic paste, respectively. In this case, when an internal-circuit-elements film is an internal electrode arranged so that electric capacity may be formed while it is mutual, a laminated ceramic capacitor can be manufactured.

[0040]It is in other specific embodiments of this invention in the end of magnetic body ceramic powder both the end of ceramic powder it is contained in ceramic slurry and ceramic paste, respectively. In this case, when an internal-circuit-elements film is a coil conductor film prolonged in a coiled form, a lamination ceramic inductor can be manufactured.

[0041]This invention is turned also to a lamination type ceramic electronic component obtained again by a manufacturing method which was mentioned above.

[0042]  
[Embodiment of the Invention]One embodiment of this invention is described about the manufacturing method of a laminated ceramic capacitor. The manufacturing method of the laminated ceramic capacitor by this embodiment can be explained referring to [drawing 1](#) thru/or [drawing 3](#) mentioned above.

[0043]In carrying out this embodiment, the ceramic paste for the conductive paste for the ceramic slurry for the ceramic green sheet 2 and the internal electrode 1 and the ceramic green layer 5 for level difference absorption is prepared, respectively.

[0044]Above-mentioned ceramic slurry is produced by mixing dielectric ceramic powder, an organic binder, a plasticizer, and a comparatively low-boiling-point organic solvent. In order to obtain the ceramic green sheet 2 from this ceramic slurry, on a base material (not shown) like polyester film coated by silicone resin as a remover, etc., Ceramic slurry is fabricated by a doctor blade method etc., and, subsequently is dried. After desiccation, each thickness of the ceramic green sheet 2 shall be several micrometers.

[0045]On the principal surface of the above ceramic green sheets 2, after the internal electrode's 1 drying, it is formed with a thickness of about 1 micrometer, so that it may be distributed over two or more places. The internal electrode 1 gives conductive paste by

screen-stencil etc., and is formed by drying this, for example. This internal electrode 1 has predetermined thickness, respectively, therefore the level difference by this thickness is brought about on the ceramic green sheet 2.

[0046]Next, it is on the principal surface of the ceramic green sheet 2, and the ceramic green layer 5 for level difference absorption is formed in the field in which the internal electrode 1 is not formed so that the level difference by the thickness of the internal electrode 1 mentioned above may be lost substantially. The ceramic green layer 5 for level difference absorption is formed by having a negative pattern of the internal electrode 1 and giving the ceramic paste mentioned above by screen-stencil etc., and, subsequently is dried. The ceramic paste used here serves as the feature in this invention, and those details are later mentioned for it.

[0047]After forming the ceramic green layer 5 for level difference absorption, it may be made have formed the ceramic green layer 5 for level difference absorption in the explanation mentioned above, after forming the internal electrode 1, but to form the internal electrode 1 conversely.

[0048]As mentioned above, the composite structure 6 in which the internal electrode 1 and the ceramic green layer 5 for level difference absorption were formed on the ceramic green sheet 2 as shown in [drawing 2](#). More than one are prepared, and after these composite structures 6 exfoliate from a base material, they are cut by the suitable size. The raw layered product 3a as shows [drawing 1](#), a part is produced by accumulating only predetermined number of sheets and accumulating the ceramic green sheet in which the internal electrode and the ceramic green layer for level difference absorption are not further formed in the upper and lower sides.

[0049]After this raw layered product 3a is pressed in a laminating direction, as shown in [drawing 3](#), it is cut by the size which should serve as the layered product chip 4a for each laminated ceramic capacitor, and ranks second. After passing through a de binder process, a baking process is given and a multilayer capacitor is completed by forming exterior electrodes eventually.

[0050]As mentioned above, by forming the ceramic green layer 5 for level difference absorption, Between the portion in which the internal electrode 1 is located in the raw layered product 3a as a part is shown in [drawing 1](#), and the portions which are not so, Or as the difference of the thickness between the portion in which many internal electrodes 1 are arranged comparatively in the laminating direction, and the portion which is not so stops arising substantially and it is shown in [drawing 3](#), in the layered product chip 4a, it becomes difficult to produce undesirable modification. As a result, the problem of a structure defect and short defects, such as delamination and a minute crack, can be made hard to produce in the obtained laminated ceramic capacitor.

[0051]In this invention, the method of manufacturing the ceramic paste for forming the ceramic green layer 5 for level difference absorption has the feature, and the dispersibility in the end of ceramic powder included in ceramic paste can be improved by adopting this characteristic manufacturing method.

[0052]Namely, the primary dispersing process which carries out the distributed processing of the primary mixture which contains the end of ceramic powder, and the 1st organic solvent at least in this invention in order to manufacture ceramic paste, The removal process which removes the 1st organic solvent from a primary mixture selectively with heating is first carried out after this primary dispersing process.

[0053]Thus, since the organic binder is not yet added in a primary dispersing process, it is easy to make the distributed processing under hypoviscosity possible, therefore to improve the dispersibility in the end of ceramic powder. In this primary dispersing process, the air which is sticking to the surface in the end of ceramic powder is replaced by the 1st organic solvent, and while being able to change into the state where the end of ceramic powder was fully soaked in the 1st organic solvent, the state of aggregation in the end of ceramic powder can fully be cracked.

[0054]Next, the secondary dispersing process which carries out the distributed processing of the secondary mixture which added the organic binder to the primary mixture from which the 1st organic solvent was removed is carried out after an above-mentioned removal process. In order to manufacture ceramic paste, the 2nd organic solvent of a high boiling point is also used from the 1st organic solvent in addition to the 1st above-mentioned organic solvent. The additional injection of this 2nd organic solvent may be carried out also in the stage of a secondary dispersing process, being added in the stage of a primary dispersing process, even if are added in the stage of a primary dispersing process, and added in the stage of a secondary dispersing process.

[0055] Anyway, by containing the 2nd organic solvent in the secondary mixture, and carrying out distributed processing in this state in a secondary dispersing process. Also in the stage of a secondary dispersing process, while it is possible to make viscosity of a secondary mixture comparatively low, therefore being able to maintain distributed efficiency comparatively highly, the solubility of the organic binder added in the stage of a secondary dispersing process which was mentioned above can be improved. Therefore, maintaining the high dispersibility in the end of ceramic powder acquired by the primary dispersing process as mentioned above, an organic binder can be mixed enough and uniformly, and the further grinding effect in the end of ceramic powder can also be expected.

[0056] As an organic solvent, the ceramic paste produced by making it above contains only the 2nd organic solvent substantially, even if the 1st organic solvent may remain slightly. The 2nd organic solvent makes it possible to be able to hold down the drying rate of ceramic paste to below a predetermined value, for example, to apply screen-stencil satisfactorily from the 1st organic solvent, since it is a high boiling point.

[0057] In the primary dispersing process and secondary dispersing process which are carried out in this invention, distributed processing can be carried out, for example with the application of the usual distributed processing machine using media like a ball mill.

[0058] What is necessary is for some to be various and just to choose, respectively what is used as the thing used as the 1st organic solvent, and the 2nd organic solvent in consideration of the boiling point of such an organic solvent in this invention, as an organic solvent used as the 1st organic solvent or 2nd organic solvent.

[0059] As an example of such an organic solvent, methyl ethyl ketone, methyl isobutyl ketone, Hydrocarbon, such as ketone, such as acetone, toluene, benzene, xylene, and normal hexane. Alcohols, such as methanol, ethanol, isopropanol, butanol, and amyl alcohol, Ester species, such as ethyl acetate, butyl acetate, and isobutyl acetate, diisopropyl ketone, Ethyl Cellosolve, butyl Cellosolve, Cellosolve acetate, methyl Cellosolve acetate, Butylcarbitol, cyclohexanol, pine oil, a dihydroterpineol, Chlorinated hydrocarbons, such as ketone, such as isophorone, a terpineol, the SHIPRO pyrene glycol, and dimethyl phthalate, ester species, hydrocarbon, alcohols, and a methylene chloride, and these mixtures are mentioned.

[0060] About some of things quoted as an example of the organic solvent mentioned above, if each boiling point is shown in a parenthesis, Methyl ethyl ketone (79.6 \*\*), methyl isobutyl ketone (118.0 \*\*), Acetone (56.1 \*\*), toluene (111.0 \*\*), benzene (79.6 \*\*), Methanol (64.5 \*\*), ethanol (78.5 \*\*), isopropanol (82.5 \*\*), Ethyl acetate (77.1 \*\*), isobutyl acetate (118.3 \*\*), diisopropyl ketone (143.5 \*\*), Methyl Cellosolve acetate (143 \*\*), Cellosolve acetate (156.2 \*\*), Butyl Cellosolve (170.6 \*\*), cyclohexanol (160 \*\*), Although it becomes pine oil (195-225 \*\*), a dihydroterpineol (210 \*\*), isophorone (215.2 \*\*), a terpineol (219.0 \*\*), the SHIPRO pyrene glycol (231.8 \*\*), and dimethyl phthalate (282.4 \*\*). What is necessary is just to choose the 1st and 2nd organic solvents based on such the boiling point, respectively.

[0061] As for the difference of the boiling point of the 1st organic solvent, and the boiling point of the 2nd organic solvent, when the 2nd organic solvent of a high boiling point is added in the stage of a primary dispersing process with the 1st organic solvent, it is preferred that it is not less than 50 \*\*. In a removal process, it is for making easier alternative removal of only the 1st organic solvent by heat-treatment.

[0062] When screen-stencil nature is taken into consideration about the 2nd organic solvent of the high boiling point mentioned above, it is preferred to have the not less than 150 \*\* boiling point, and it is more preferred to have the boiling point which is about 200-250 \*\*. When it is easy to dry ceramic paste, therefore it is easy to produce blinding of the mesh of a printing pattern in less than 150 \*\* and it exceeds another side and 250 \*\*, it is for being hard to dry a printed film, therefore requiring for desiccation for a long time.

[0063] As an organic binder used in ceramic paste, what is dissolved in an organic solvent at a room temperature is good. As such an organic binder, for example A polyvinyl butyral, Polyacetal, such as polybutylbutyral, and poly(meta) acrylic ester. Modified cellulose, such as ethyl cellulose, alkyd, and vinylidene. There are polyether, epoxy resins, urethane resin, polyamide resin, polyimide resin, polyamide imide resin, polyester resin, polysulphone resin, liquid crystal polymers, polyimidazole resin, and poly oxazoline resin.

[0064] The polyvinyl butyral illustrated above as an organic binder is obtained by condensation with polyvinyl alcohol and butyraldehyde, an acetyl group is less than 6 mol %, and a butyral group has % of a 62-82-mol low polymerization article, an inside polymerization article, and a high polymerization article. As for the polyvinyl butyral used as an organic binder in the ceramic paste concerning this invention, while the balance of

the tough nature of dissolution viscosity and a dry paint film to the butyral group to an organic solvent is about 65 mol %, it is preferred that it is a polymerization article.

[0065]The addition of an organic binder is preferably chosen to 3 to 10% of the weight one to 20% of the weight to the end of ceramic powder.

[0066]As for a primary mixture, in the primary dispersing process mentioned above, it is preferred that an organic dispersing agent is included. That is, in a primary mixture, in the state where it is diluted with the 1st organic solvent or 1st and 2nd organic solvents, if an organic dispersing agent is added, the dispersibility in the end of ceramic powder will improve more.

[0067]Especially as an above-mentioned organic dispersing agent, as for a molecular weight, from a point of dispersibility, although not limited, it is preferred that it is 10,000 or less, an anionic system, a cation system, and the Nonion system -- although any may be sufficient -- polyacrylic acid and its ammonium salt. A polyacrylic ester copolymer, polyethylene oxide, polyoxyethylene alkyl amyl ether, Fatty acid diethanol AMALDO, polyethylenimine, polyoxypropylene monoallyl monobutyl ether, the copolymer of a maleic anhydride (and styrene), etc. are preferred.

[0068]The addition of an organic dispersing agent is preferably chosen to 0.5 to 2.0% of the weight 0.1 to 5% of the weight to the end of ceramic powder.

[0069]It is after a primary dispersing process and it is preferred that the process of filtering a primary mixture with a filter before a removal process is carried out further. This can remove a foreign matter, an aggregate in the end of ceramic powder, etc. which may be mixed into ceramic paste, and ceramic paste with higher dispersibility can be obtained certainly. The effect of decreasing a pinhole in the ceramic layer brought about after calcination of the ceramic green layer 5 for level difference absorption which consists of ceramic paste is also expectable by air of a minute diameter which has adhered in the end of ceramic powder carrying out foam breaking by filtration, or being removed.

[0070]It is preferred by dissolving an organic binder in the 2nd organic solvent beforehand to produce an organic vehicle, to add this organic vehicle, and to obtain a secondary mixture. The non-melted object of an organic binder which can be mixed in a secondary mixture by this can be lessened. In this case, if this is added after filtering an organic vehicle with a filter in order to obtain a secondary mixture, the non-melted object of an organic binder can be lessened further.

[0071]Respectively, filtration of the two above modes may be repeated two or more times, and may combine filtration of two modes. Thus, the effect by filtration can be further heightened by repeating filtration two or more times, or combining filtration of two modes.

[0072]In order to use the filter which consists of plastics, such as a filter which consists of stainless steel or polypropylene, and fluororesin, in the filtering step mentioned above and to raise filtration velocity, The method which is compulsorily extruded with compressed gas, such as air and nitrogen gas, or has been attracted enough and carried out under decompression may be adopted.

[0073]It is preferred that it is what has the substantially same presentation as the end of ceramic powder it is contained in the ceramic slurry used in order to fabricate the ceramic green sheet 2 the end of ceramic powder it is contained in ceramic paste. It is for coinciding a degree of sintering between the ceramic green layer 5 for level difference absorption, and the ceramic green sheet 2.

[0074]I hear that it is the same that the main ingredients have the same presentation substantially [\*\*\*\*], and it is. For example, even if accessory constituents, such as a minute amount addition metal oxide and glass, differ, it can be said that it has the same presentation substantially. If the end of ceramic powder it is contained in the ceramic green sheet 2 is a thing of the range which satisfies X7R characteristic specified by the B weighting specified by JIS about the temperature characteristics of electric capacity, and EIA standard, The main ingredients are the same, and as long as it satisfies B weighting and X7R characteristic, the accessory constituent may also be different the end of ceramic powder it is contained in the ceramic paste for the ceramic green layer 5 for level difference absorption.

[0075]It is for [drawing 4](#) explaining the manufacturing method of the lamination ceramic inductor as other embodiments of this invention. It is a perspective view decomposing and showing the element which constitutes the raw layered product 13 prepared in order to obtain the layered product chip 12 with which the lamination ceramic inductor 11 which showed [drawing 5](#) appearance with the perspective view, and which was manufactured by this manufacturing method is equipped.

[0076]The raw layered product 13 is obtained two or more ceramic green sheets 14, 15,

16, and 17, --, by having 18 and 19 and laminating these ceramic green sheets 14-19.

[0077]The ceramic green sheets 14-19 fabricate ceramic slurry including the end of magnetic body ceramic powder with a doctor blade method etc., and are obtained by drying. After desiccation, each thickness of the ceramic green sheets 14-19 shall be 10-30 micrometers.

[0078]The coil conductor film and the ceramic green layer for level difference absorption which are prolonged in a coiled form are formed in the ceramic green sheets 15-18 located in the middle among the ceramic green sheets 14-19 so that it may explain in detail below.

[0079]First, the coil conductor film 20 is formed on the ceramic green sheet 15. The coil conductor film 20 is formed so that the 1st end may reach even the edge of the ceramic green sheet 15. The beerhole conductor 21 is formed in the 2nd end of the coil conductor film 20.

[0080]In order to form such the coil conductor film 20 and the beerhole conductor 21, For example, after forming the breakthrough for the beerhole conductor 21 in the ceramic green sheet 15 by methods, such as laser or punching, screen-stencil etc. give the conductive paste used as the coil conductor film 20 and the beerhole conductor 21, and drying is performed.

[0081]It is on the principal surface of the ceramic green sheet 15, and the ceramic green layer 22 for level difference absorption is formed in the field in which the coil conductor film 20 is not formed so that the level difference by the thickness of the coil conductor film 20 mentioned above may be lost substantially. The ceramic green layer 22 for level difference absorption gives ceramic paste including the end of magnetic body ceramic powder it mentioned above, and it becomes the feature in this invention by screen-stencil etc., and is formed by drying.

[0082]Next, on the ceramic green sheet 16, the coil conductor film 23, the beerhole conductor 24, and the ceramic green layer 25 for level difference absorption are formed by the method mentioned above and the same method. The 1st end of the coil conductor film 23 is connected to the 2nd end of the coil conductor film 20 via the beerhole conductor 21 mentioned above. The beerhole conductor 24 is formed in the 2nd end of the coil conductor film 23.

[0083]Next, on the ceramic green sheet 17, the coil conductor film 26, the beerhole conductor 27, and the ceramic green layer 28 for level difference absorption are formed similarly. The 1st end of the coil conductor film 26 is connected to the 2nd end of the coil conductor film 23 via the beerhole conductor 24 mentioned above. The beerhole conductor 27 is formed in the 2nd end of the coil conductor film 26.

[0084]Lamination of the ceramic green sheets 16 and 17 mentioned above is repeated two or more times if needed.

[0085]Next, on the ceramic green sheet 18, the coil conductor film 29 and the ceramic green layer 30 for level difference absorption are formed. The 1st end of the coil conductor film 29 is connected to the 2nd end of the coil conductor film 26 via the beerhole conductor 27 mentioned above. The coil conductor film 29 is formed so that the 2nd end may reach even the edge of the ceramic green sheet 18.

[0086]Each thickness of the coil conductor films 20, 23, 26, and 29 mentioned above shall be about 30 micrometers after desiccation.

[0087]In the raw layered product 13 produced by laminating two or more composite structures which contain such ceramic green sheets 14-19, respectively, The coil conductor of two or more turns is formed as a whole by connecting two or more coil conductor films 20, 23, 26, and 29 respectively prolonged in a coiled form one by one via the beerhole conductors 21, 24, and 27.

[0088]By calcinating the raw layered product 13, the layered product chip 12 for the lamination ceramic inductor 11 shown in [drawing 5](#) is obtained. Although the raw layered product 13 is illustrated as a thing for obtaining the one layered product chip 12 by [drawing 4](#), it is produced as a thing for obtaining two or more layered product chips, and it may be made to take out two or more layered product chips by cutting this.

[0089]Subsequently, as shown in [drawing 5](#), at each end in which the layered product chip 12 carries out for relativity. The exterior electrodes 30 and 31 are formed and the lamination ceramic inductor 11 is completed by it so that it may be connected to the 1st end of the coil conductor film 20 and the 2nd end of the coil conductor film 29 which were mentioned above, respectively.

[0090]In the lamination ceramic inductor 11 explained with reference to the laminated ceramic capacitor explained with reference to [drawing 1](#) thru/or [drawing 3](#) or [drawing 4](#), and [drawing 5](#), As the end of ceramic powder it is contained in the ceramic green sheet 2,



14-19, the ceramic green layer 5 for level difference absorption, or 22, 25, 28 and 30, Typically, the end of non-oxide stock ceramic powder, such as silicon carbide, silicon nitride, and sialon, is mentioned in the end of oxide stock ceramic powder, such as alumina, zirconia, magnesia, titanium oxide, barium titanate, lead zirconate titanate, and ferrite manganese. As a powder grain size, an average of 5 micrometers or less of things of a 1-micrometer globular form or the letter of grinding are used more preferably.

[0091]When the content of the alkali metal oxide contained as an impurity uses 0.1 or less % of the weight of barium titanate as the end of ceramic powder, following metallic oxides and glass components may be made to contain as a minor constituent to this end of ceramic powder.

[0092]As a metallic oxide, there is an oxidation terbium, oxidation dysprosium, holmium oxide, erbium oxide, ytterbium oxide, manganese oxide, cobalt oxide, nickel oxide, or magnesium oxide.

[0093]As a glass component,  $\text{Li}_2\text{-(SiTi) O}_2\text{-MO}$ . (-- however, MO -- aluminum<sub>2</sub>O<sub>3</sub> or ZrO<sub>2</sub>).  $\text{SiO}_2\text{-TiO}_2\text{-MO}$  (however, MO) [ BaO and ] CaO, SrO, MgO, ZnO or MnO,  $\text{Li}_2\text{O-B}_2\text{O}_3\text{-(SiTi) O}_2\text{+MO}$ . (however, MO has aluminum<sub>2</sub>O<sub>3</sub> or ZrO<sub>2</sub>),  $\text{B}_2\text{O}_3\text{-aluminum}_2\text{O}_3\text{-MO}$  (however, MO BaO, CaO, SrO, or MgO), or SiO<sub>2</sub>.

[0094]In the lamination ceramic inductor 11 explained with reference to the laminated ceramic capacitor explained with reference to [drawing 1](#) thru/ or [drawing 3](#) or [drawing 4](#), and [drawing 5](#). As conductive paste for the internal electrode 1 or the coil conductor films 20, 23, 26, and 29, the beerhole conductors 21 and 24, and formation of 27 used, the following can be used, for example.

[0095]As conductive paste used in a laminated ceramic capacitor, 0.02 micrometer - 3 micrometers of mean particle diameter are 0.05-0.5 micrometer preferably, Ag/Pd this powder including conductive powder, nickel metal powder, or copper metal powder etc. which consists of 60 % of the weight/40 % of the weight - 10 % of the weight/90 % of the weight of alloys 100 weight sections, An organic binder Two to 20 weight section (preferably five to 10 weight section), and Ag as a sintering depressant, Metal resin, such as Au, Pt, Ti, Si, nickel, or Cu, by metal conversion About 0.1 to 3 weight section (preferably 0.5 to 1 weight section). After kneading about 35 weight sections for an organic solvent with 3 rolls, the conductive paste obtained by adding the same or another organic solvent further, and performing viscosity control can be used.

[0096]As conductive paste used in the lamination ceramic inductor 11, This powder receives 100 weight sections including the conductive powder in which Ag/Pd consists of 80 % of the weight/20 % of the weight - 100 % of the weight/0 % of the weight of alloys, or Ag. After kneading the same organic binder as a case, sintering depressant, and organic solvent of the conductive paste for the laminated ceramic capacitor mentioned above with 3 rolls by the same ratio, The conductive paste obtained by adding the same or another organic solvent further, and performing viscosity control can be used.

[0097]Below, this invention is more concretely explained based on the example of an experiment.

[0098]

[The example 1 of an experiment] The example 1 of an experiment is related with a laminated ceramic capacitor, and in manufacture of the ceramic paste for the ceramic green layer for level difference absorption, it is carried out in order to check the effect by having adopted the primary dispersing process and secondary dispersing process as a feature of this invention.

[0099](Preparation in the end of ceramic powder) Drying desiccation was carried out after carrying out weighing of barium carbonate ( $\text{BaCO}_3$ ) and the titanium oxide ( $\text{TiO}_2$ ) first so that it may become a mole ratio of 1:1, and carrying out wet blending using a ball mill. Subsequently, after carrying out temporary quenching at the temperature of 1000 \*\* for 2 hours, dielectric ceramic powder was obtained by grinding.

[0100](Preparation of ceramic slurry, and production of a ceramic green sheet) In the end of ceramic powder it prepared previously 100 weight sections, Polyvinyl-butylal 7 weight section of an inside degree of polymerization and the degree of raise in butylal, As a plasticizer DOP(diethyl phthalate)3 weight section, methyl-ethyl-ketone 30 weight section, ethanol 20 weight section, and toluene 20 weight section with product ball made from zirconia 600 weight section 1 mm in diameter. It supplied to the ball mill, wet blending was performed for 20 hours, and dielectric ceramic slurry was obtained.

[0101]And to this dielectric ceramic slurry, the doctor blade method was applied and the 3

micrometers (the thickness after calcination is 2 micrometers)-thick dielectric ceramic green sheet was fabricated. Desiccation is 80 °C and was performed for 5 minutes.

[0102](Preparation of conductive paste) Metal powder 100 weight section of Ag/Pd=30/70, After kneading ethyl cellulose 4 weight section, the amount part of alkyd-resin duplex, Ag metal resinate 3 weight section (17.5 weight sections as Ag), and butylcarbitol acetate 35 weight section with 3 rolls, terpineol 35 weight section was added and viscosity control was performed.

[0103](Preparation of the ceramic paste for the ceramic green layer for level difference absorption)

- Sample 1 (EXAMPLE) - Dielectric-ceramic-powder 100 weight section prepared previously, methyl-ethyl-ketone (79.6 °C of boiling points) 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours.

[0104]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone as a solvent was removed.

[0105]After removing methyl ethyl ketone thoroughly, dielectric ceramic paste was obtained by kneading the mixture produced by adding terpineol (219.0 °C of boiling points) 40 weight section, and ethyl cellulose resin 5 weight section with 3 rolls.

Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0106]- Sample 2 (EXAMPLE) - Dielectric-ceramic-powder 100 weight section prepared previously, methyl-ethyl-ketone 70 weight section, polyacrylic acid quaternary-ammonium-salt dispersing agent (weight average molecular weight 1000) 0.5 weight section as an organic dispersing agent, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours.

[0107]Henceforth, dielectric ceramic paste was obtained through the same operation as the sample 1.

[0108]- Sample 3 (EXAMPLE) - Dielectric-ceramic-powder 100 weight section prepared previously, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours.

[0109]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone was removed.

[0110]After removing methyl ethyl ketone thoroughly, the mixture produced by the planetary mixer by adding, the resin solution, i.e., the organic vehicle, in which terpineol 40 weight section was made to dissolve ethyl cellulose resin 5 weight section beforehand, Dielectric ceramic paste was obtained by kneading with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0111]- Sample 4 (EXAMPLE) - Dielectric-ceramic-powder 100 weight section prepared previously, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours.

[0112]Next, this mixture was absolutely filtered under application of pressure with the filter of 20 micrometers (a not less than 10-micrometer formed element is removable with the probability of 99.7%) of filtration.

[0113]Next, it moves to the container made from stainless steel, and the mixture after this filtration was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone was removed.

[0114]After removing methyl ethyl ketone thoroughly, dielectric ceramic paste was obtained by kneading the mixture produced by adding terpineol 40 weight section and ethyl cellulose resin 5 weight section with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0115]- Sample 5 (EXAMPLE) - Dielectric-ceramic-powder 100 weight section prepared previously, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was

performed for 16 hours.

[0116]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven and it was made to dry, and methyl ethyl ketone was removed and the dried granular material was obtained.

[0117]On the other hand, the resin solution in which terpineol 40 weight section was made to dissolve ethyl cellulose resin 5 weight section beforehand with a planetary mixer was absolutely filtered with the filter of 20 micrometers of filtration, and the organic vehicle was obtained.

[0118]Next, dielectric ceramic paste was obtained by mixing a front dried powder object and this organic vehicle, and kneading this mixture with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0119]- Sample 6 (EXAMPLE) - Dielectric-ceramic-powder 100 weight section prepared previously, methyl-ethyl-ketone 70 weight section, terpineol 10 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours.

[0120]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone was removed.

[0121]After removing methyl ethyl ketone thoroughly, dielectric ceramic paste was obtained by kneading the mixture produced by adding terpineol 30 weight section and ethyl cellulose resin 5 weight section with 3 rolls. Subsequently, the sake [ for viscosity control ], about ten weight sections of terpineols added, and the automatic mortar distributed and adjusted.

[0122]- Sample 7 (comparative example) - After mixing dielectric-ceramic-powder 100 weight section prepared previously, terpineol 40 weight section, and ethyl cellulose resin 5 weight section with an automatic mortar, it kneaded well with 3 rolls and dielectric ceramic paste was obtained.

[0123](Production of a laminated ceramic capacitor) In order to form an internal electrode on the principal surface of the dielectric ceramic green sheet prepared previously, conductive paste was screen-stenciled and it dried for 10 minutes at 80 \*\*. The size, the shape, and the position of the internal electrode were set up suit the layered product chip obtained at a next process. Next, in order to form the green dielectric ceramic layer for level difference absorption on the principal surface of a dielectric ceramic green sheet, each dielectric ceramic paste concerning the samples 1 thru/or 7 was screen-stenciled, and it dried for 10 minutes at 80 \*\*. It was made for each thickness of an internal electrode and the green dielectric ceramic layer for level difference absorption to be set to 1 micrometer (the thickness after calcination is 0.5 micrometer) after desiccation.

[0124]Next, the dielectric ceramic green sheet of 200 sheets which forms the internal electrode and the green dielectric ceramic layer for level difference absorption as mentioned above, It put so that it might put with the dielectric ceramic green sheet of several ten sheets in which the internal electrode etc. are not given, and the raw layered product was produced, and heat pressing of this layered product was carried out according to the pressurizing condition of 1000 kg/cm<sup>2</sup> at 80 \*\*.

[0125]Next, two or more layered product chips were obtained by cutting an above-mentioned raw layered product with the cutting edge so that it might become a size with a 3.2 mm[ in length ] x 1.6-mm thickness of 1.6 mm after calcination. [ in width ]

[0126]Next, zirconia powder aligned two or more above-mentioned layered product chips on the setter for the calcination by which the low volume spray was carried out, carried out temperature up over 24 hours from a room temperature to 250 \*\*, and removed the organic binder. Next, the layered product chip was supplied to the firing furnace, and it calcinated by the profile of about 20 hours at a maximum of 1300 \*\*.

[0127]Next, after supplying the obtained sintered compact chip to a barrel and performing end polishing, exterior electrodes were provided in the both ends of the sintered compact, and the laminated ceramic capacitor used as a sample was completed.

[0128](Evaluation of the characteristic) The various characteristics were evaluated about the dielectric ceramic paste and the laminated ceramic capacitor concerning the samples 1 thru/or 7 mentioned above. The result is shown in Table 1.

[0129]

[Table 1]

試料番号	実施例						比較例
	1	2	3	4	5	6	7
固形分(重量%)	66	67	66	67	66	66	67
粘度(Pa·s)	10	12	10	14	10	9	12
分散度	-0.1	-0.2	-0.1	-0.2	-0.1	-0.2	0.3
印刷厚み( $\mu\text{m}$ )	3	2	3	2	3	3	5
Ra( $\mu\text{m}$ )	0.4	0.3	0.4	0.3	0.4	0.3	1.5
構造欠陥不良率(%)	1.5	1	1.3	1	1	1.0	80

[0130]Characterization in Table 1 was performed as follows.

[0131]"Solid content": About 1 g of ceramic paste was weighed precisely, and it computed in heat convection type oven from the weight after neglecting it at 150 °C for 3 hours.

[0132]"Viscosity": 2.5-rpm rotation was given and measured  $\eta$  in  $\text{Pa}\cdot\text{s}$  using the Tokyo Keiki B type viscosity meter  $\eta$  for the viscosity of ceramic paste / 20 °C ].

[0133]"Degree of dispersion": It computed from the particle size distribution acquired by measuring the particle size distribution in the end of ceramic powder using an optical diffraction type size distribution measuring device. That is, the end of ceramic powder it prepared previously was underwater distributed using the ultrasonic homogenizer, the ultrasonic wave was impressed till the place where a grain size does not become small any more, the grain size of D90 at that time was recorded, and this was made into the marginal grain size. On the other hand, ceramic paste was diluted in ethanol, the grain size of D90 of particle size distribution was recorded, and this was made into the grain size of a paste. And the degree of dispersion was computed based on the formula of degree-of-dispersion = (grain size / marginal grain size of paste)-1. This degree of dispersion shows that dispersibility is so good that a value is [ zero ] near if a numerical value is +, and shows that dispersibility is so good that an absolute value is large if a numerical value is -.

[0134]By using the 50-micrometer-thick screen made from stainless steel by 400 meshes on a "printing thickness":96% alumina substrate, printing at emulsion 20 micrometers in thickness, and drying for 10 minutes at 80 °C, forming the printed film for evaluation -- the thickness -- a ratio -- it asked from the measurement result by the laser surface roughness meter of a contact process.

[0135]"Ra(surface roughness)": -- the value which equalized the absolute value of the deviation of the center line and roughness curve which formed the same printed film for evaluation as the case of the above "printing thickness", and equalized the surface roughness Ra, i.e., a wave, -- a ratio -- it asked from the measurement result by the laser surface roughness meter of a contact process.

[0136]"Structure-defect defective fraction": When abnormalities were seen by the visual examination of the sintered compact chip for the obtained laminated ceramic capacitor, and the inspection by an acoustic microscope, the internal structure defect was checked by polish and (sintered compact chip number with structure defect)/(total of a sintered compact chip) was made into the structure defect defective fraction.

[0137]If Table 1 is referred to, according to the samples 1-6 concerning the example of this invention which adopted the primary dispersing process and the secondary dispersing process, and added the organic binder in the secondary dispersing process. It turns out that the result of could acquire the outstanding dispersibility compared with the sample 7 as a comparative example which did not perform such a thing, and having excelled also in each item of printing thickness, surface roughness, and a structure defect defective fraction is shown.

[0138]

[The example 2 of an experiment] The example 2 of an experiment is related with a lamination ceramic inductor, and in manufacture of the ceramic paste for the ceramic green layer for level difference absorption, it is carried out in order to check the effect by having adopted the primary dispersing process and secondary dispersing process as a feature of this invention.

[0139](Preparation in the end of ceramic powder) Drying desiccation was carried out after ferric oxide carried out weighing so that a 49.0-mol zinc oxide will be 29.0-mol %, nickel oxide will be 14.0-mol % and copper oxide may be 8.0-mol %, and it carried out wet blending using a ball mill. Subsequently, after carrying out temporary quenching at 750 °C for 1 hour, the end of magnetic body ceramic powder was obtained by grinding.

[0140](Preparation of ceramic slurry, and production of a ceramic green sheet) In the end of magnetic body ceramic powder it prepared previously 100 weight sections, The solvent which consists of dispersing agent 0.5 weight section which consists of maleic acid copolymers, and methyl-ethyl-ketone 30 weight section and toluene 20 weight section

with product ball made from zirconia 600 weight section 1 mm in diameter. After supplying to the ball mill and stirring for 4 hours, DOP3 weight section and ethanol 20 weight section were added as a plasticizer with polyvinyl-butylal 7 weight section of the inside degree of polymerization as an organic binder, and the degree of raise in butylal, wet blending was performed for 20 hours, and magnetic body ceramic slurry was obtained. [0141]And to this magnetic body ceramic slurry, the doctor blade method was applied and the 20 micrometers (the thickness after calcination is 15 micrometers)-thick magnetic body ceramic green sheet was fabricated. Desiccation is 80 \*\* and was performed for 5 minutes. [0142](Preparation of conductive paste) After kneading metal powder 100 weight section of Ag/Pd=80/20, ethyl cellulose 4 weight section, the amount part of alkyd-resin duplexes, and butylcarbitol acetate 35 weight section with 3 rolls, terpineol 35 weight section was added and viscosity control was performed. [0143](Preparation of the ceramic paste for the ceramic green layer for level difference absorption)

- Sample 8 (EXAMPLE) - 100 weight sections, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours in the end of magnetic body ceramic powder it prepared previously.

[0144]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone as a solvent was removed.

[0145]After removing methyl ethyl ketone thoroughly, magnetic body ceramic paste was obtained by kneading the mixture produced by adding terpineol 40 weight section and ethyl cellulose resin 5 weight section with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0146]- Sample 9 (EXAMPLE) - In the end of magnetic body ceramic powder it prepared previously 100 weight sections, Methyl-ethyl-ketone 70 weight section, polyacrylic acid quarternary-ammonium-salt dispersing agent (weight average molecular weight 1000) 0.5 weight section as an organic dispersing agent, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours.

[0147]Henceforth, magnetic body ceramic paste was obtained through the same operation as the sample 1.

[0148]- Sample 10 (EXAMPLE) - 100 weight sections, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours in the end of magnetic body ceramic powder it prepared previously.

[0149]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone was removed.

[0150]After removing methyl ethyl ketone thoroughly, the mixture produced by the planetary mixer by adding, the resin solution, i.e., the organic vehicle, in which terpineol 40 weight section was made to dissolve ethyl cellulose resin 5 weight section beforehand, Magnetic body ceramic paste was obtained by kneading with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0151]- Sample 11 (EXAMPLE) - 100 weight sections, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours in the end of magnetic body ceramic powder it prepared previously.

[0152]Next, this mixture was absolutely filtered under application of pressure with the filter of 20 micrometers of filtration.

[0153]Next, it moves to the container made from stainless steel, and the mixture after this filtration was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven, it was made to dry, and methyl ethyl ketone was removed.

[0154]After removing methyl ethyl ketone thoroughly, magnetic body ceramic paste was obtained by kneading the mixture produced by adding terpineol 40 weight section and ethyl cellulose resin 5 weight section with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic

mortar distributed and adjusted.

[0155]- Sample 12 (EXAMPLE) - 100 weight sections, methyl-ethyl-ketone 70 weight section, and product ball made from zirconia 600 weight section 1 mm in diameter were supplied to the ball mill, and wet blending was performed for 16 hours in the end of magnetic body ceramic powder it prepared previously.

[0156]Next, it moves to the container made from stainless steel, and this mixture was neglected one whole day and night, and was made to sediment. And after removing supernatant liquid, put sediment into a convection oven and it was made to dry, and methyl ketone was removed and the dried granular material was obtained.

[0157]On the other hand, the resin solution in which terpineol 40 weight section was made to dissolve ethyl cellulose resin 5 weight section beforehand with a planetary mixer was absolutely filtered with the filter of 20 micrometers of filtration, and the organic vehicle was obtained.

[0158]Next, magnetic body ceramic paste was obtained by mixing a front dried powder object and this organic vehicle, and kneading this mixture with 3 rolls. Subsequently, the sake [ for viscosity control ], terpineol 10-20 weight-section addition was carried out, and the automatic mortar distributed and adjusted.

[0159]- Sample 13 (comparative example) - After mixing 100 weight sections, terpineol 40 weight section, and ethyl cellulose resin 5 weight section with an automatic mortar, it kneaded well with 3 rolls and magnetic body ceramic paste was obtained in the end of magnetic body ceramic powder it prepared previously.

[0160](Production of a lamination ceramic inductor) So that the coil conductor prolonged in a coiled form after lamination of two or more magnetic body ceramic green sheets can be formed, While forming the breakthrough for a beerhole conductor in the position of the magnetic body ceramic green sheet prepared previously, In order to form a beerhole conductor in a coil conductor film and a breakthrough on the principal surface of a magnetic body ceramic green sheet, conductive paste was screen-stenciled and it dried for 10 minutes at 80 \*\*. Next, in order to form the magnetic body ceramic green layer for level difference absorption on a magnetic body ceramic green sheet, each magnetic body ceramic paste concerning the samples 8 thru/or 13 was screen-stenciled, and it dried for 10 minutes at 80 \*\*. It was made for each thickness of a coil conductor film and the magnetic body ceramic green layer for level difference absorption to be set to 30 micrometers (the thickness after calcination is 20 micrometers) after desiccation.

[0161]Next, while piling up the magnetic body ceramic green sheet of 11 sheets which forms the coil conductor film, the beerhole conductor, and the ceramic green layer for level difference absorption as mentioned above so that a coil conductor may be formed, The magnetic body ceramic green sheet which does not form the coil conductor film etc. in those upper and lower sides was piled up, the raw layered product was produced, and heat pressing of this layered product was carried out under the application of pressure of 1000 kg/cm<sup>2</sup> at 80 \*\*.

[0162]Next, two or more layered product chips were obtained by cutting an above-mentioned raw layered product with the cutting edge so that it might become a size with a 3.2 mm [ in length ] x 1.6-mm thickness of 1.6 mm after calcination. [ in width ]

[0163]Next, after removing an organic binder by heating an above-mentioned layered product chip at 400 \*\* for 2 hours, calcination for 90 minutes was performed at 920 \*\*.

[0164]Next, after supplying the obtained sintered compact chip to a barrel and performing end polishing, the main ingredients provided the exterior electrodes which are silver in the both ends of the sintered compact, and the chip shape lamination ceramic inductor used as a sample was completed.

[0165](Evaluation of the characteristic) About the ceramic paste and the lamination ceramic inductor concerning the samples 8 thru/or 13 mentioned above, the result of having evaluated the various characteristics is shown in Table 2.

[0166]

[Table 2]

試料番号	実例						比較例
	8	9	10	11	12	13	
固形分(重量%)	70	71	70	71	70	71	71
粘度(Pa・s)	20	22	20	22	21	21	21
分散度	0.3	0.2	0.2	0.2	0.1	1.0	
印刷厚み(μm)	10	12	13	11	12	16	
Ra(μm)	0.5	0.5	0.6	0.4	0.5	1.7	
標準欠陥不良率(%)	2.0	0.5	1.0	0.5	0.5	70	

[0167]The characterization method in Table 2 is the same as that of the case of Table 1.

[0168]According to the samples 8-12 concerning the example of this invention which adopted the primary dispersing process and the secondary dispersing process, and added the organic binder in the secondary dispersing process like [ if Table 2 is referred to ] the case of the example 1 of an experiment shown in Table 1. It turns out that the result of could acquire the outstanding dispersibility compared with the sample 13 as a comparative example which did not perform such a thing, and having excelled also in each item of printing thickness, surface roughness, and a structure defect defective fraction is shown.

[0169]As mentioned above, although the case where dielectric ceramic powder or the end of magnetic body ceramic powder was used was explained as the end of ceramic powder it is contained in the ceramic paste concerning this invention, In this invention, it is not influenced by the electrical property in the end of ceramic powder used, and even if it uses [ therefore ] the end of end of insulator ceramic powder, or piezo electric crystal ceramic powder, etc., for example, the ceramic paste which can expect the same effect can be obtained.

[0170]

[Effect of the Invention]As mentioned above, the primary dispersing process which carries out the distributed processing of the primary mixture which contains the end of ceramic powder, and the 1st organic solvent at least in manufacturing ceramic paste according to this invention. The removal process which removes the 1st organic solvent from a primary mixture selectively with heating after a primary dispersing process. The secondary dispersing process which carries out the distributed processing of the secondary mixture which added the organic binder to the primary mixture from which the 1st organic solvent was removed after the removal process. Since the process which includes the 2nd organic solvent of a high boiling point in a primary mixture and/or said secondary mixture from the 1st organic solvent was carried out, the dispersibility in the end of ceramic powder included in ceramic paste should be excelled. Therefore, when it must have high pattern accuracy and a very thin ceramic green layer must be formed, such ceramic paste can be used advantageously.

[0171]Therefore, in [ according to this invention ] a lamination type ceramic electronic component, In order to form the ceramic green layer for level difference absorption in the field in which it is on the principal surface of a ceramic green sheet, and an internal-circuit-elements film is not formed so that the level difference by the thickness of an internal-circuit-elements film may be lost substantially. By using the above ceramic paste, a lamination type ceramic electronic component with high reliability without structure defects, such as a crack and delamination, is realizable.

[0172]It becomes possible according to this invention to fully satisfy the demand of the miniaturization of a lamination type ceramic electronic component, and a weight saving. When this invention is applied to a laminated ceramic capacitor, a miniaturization and large-scale-izing of a laminated ceramic capacitor can be attained advantageously. When this invention is applied to a lamination ceramic inductor, miniaturization of a lamination ceramic inductor and high inductance-ization can be attained advantageously.

[0173]When the 2nd organic solvent of a high boiling point is added in a secondary dispersing process, since it can avoid making the 2nd organic solvent exist in a primary mixture, in a removal process, the 1st organic solvent can be removed more easily.

[0174]More preferably in in an above-mentioned case, being added after the organic binder has dissolved in the 2nd organic solvent beforehand. Thus, if it is added after the organic binder which dissolved in the 2nd organic solvent beforehand is filtered, the non-melted object of the organic binder which can be mixed into ceramic paste can be lessened.

[0175]On the other hand, when the primary mixture by which distributed processing is carried out in a primary dispersing process contains the 2nd organic solvent further. Since the fall of the viscosity of the primary mixture by the 2nd organic solvent is expectable, when a primary dispersing process is carried out, improvement in the dispersibility in the end of ceramic powder due to the fall of this viscosity can be expected.

[0176]In an above-mentioned case, in a removal process, alternative removal of only the 1st organic solvent by heat-treatment can be made easier by the difference of the boiling point of the 1st organic solvent and the boiling point of the 2nd organic solvent being not less than 50 \*\*.

[0177]If the process of preparing ceramic paste is after a primary dispersing process and is further provided with the process of filtering a primary mixture, before the removal process in this invention, A foreign matter, an aggregate in the end of ceramic powder, etc.

which may be mixed into ceramic paste can be removed, and ceramic paste with higher dispersibility can be obtained certainly. The effect of decreasing a pinhole in the ceramic layer after calcination is also expectable.

[0178]In the manufacturing method of the lamination type ceramic electronic component concerning this invention, The ceramic slurry used in order to fabricate a ceramic green sheet, If it is made to include the end of ceramic powder it has the substantially same presentation as the end of ceramic powder it is contained in the ceramic paste for forming the ceramic green layer for level difference absorption, The degree of sintering of a ceramic green sheet and the ceramic green layer for level difference absorption can be coincided, and generating of the crack by the disagreement of such a degree of sintering or delamination can be prevented.

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[Translation done.]